INFLATABLE INTRAOCULAR LENS

BACKGROUND OF THE INVENTION

This invention relates to intraocular lenses and, more particularly to a lens which employs a fluid as its primary lens medium.

Intraocular lenses generally consist of a medial lens body and a plurality of lateral lobes or position fixing elements (haptics) projecting from the circumference of the lens body for fixing the lens in the eye. The insertion of such a lens in the eye requires the surgeon to make a corneo-scleral incision sufficiently long to not only accommodate the passage of the lens, but also the position fixing haptics. Historically, the length of such an incision has approximated 6 to 9 mm.

Efforts have been made, and continue to be made to reduce the length of the required incision by redesign of the lens structure. In my copending patent application, entitled "Intraocular Lens with Retractable Legs", Ser. No. 649,798, I describe an intraocular lens wherein the positioning haptics are held in a retracted position until the lens is inserted in the eye, at which time the surgeon releases the haptics which automatically act to properly position the lens. Such a lens structure enables the surgeon to emplace with ease, the lens in the capsular bag and assures the least traumatic effect on the patient.

Other intraocular lenses of different design, but whose purpose is to reduce the dimension of the surgeon's incision, are shown in U.S. Pat. Nos. 4,296,501 and 4,343,050 to Charles Kelman.

All of the above-mentioned lenses are "solid" in that their minimum size is determined by the size of the lens element, notwithstanding what is done to the lens' positioning elements. In U.S. Pat. No. 4,466,705 of Paul Michelson, an intraocular capsular lens is described whose lens medium is a liquid material. Michelson's capsule is constructed of a semipermeable transparent membrane which is inserted in a dehydrated state into the eye. The capsule then hydrates and expands to a lens-like shape. Since the lens is inserted in a dehydrated state, Michelson suggests that it can be inserted through a small incision by folding or rolling it into a compact form. While this design does substantially reduce the size of the required incision (to 3 or 4 mm), the final lens configuration is difficult to control. In addition, there is no way to correct for any malformation of the lens once it is in place, if for any reason, the lens does not hydrate in accordance with expectations.

Recently, it has been reported that cataracts may be removed by phacoemulsification through a one millimeter non-sutured incision (ie. see Shearing, et al. pp. 6–11, *CATARACT* January 1985). Unfortunately there has been no intraocular lens which could be inserted through such a small incision.

OBJECTS OF THE INVENTION

It is an object of the invention to provide an intraocular lens whose insertion into the eye may be accomplished through a minimal incision.

A further object of the invention is to provide an intraocular lens whose characteristics are adjustable after insertion.

SUMMARY OF THE INVENTION

In accordance with the aforementioned objects, an intraocular lens has been developed which comprises impermeable, anterior and posterior transparent sheets joined to make a lens cavity. Appropriate haptics depend from the periphery of the lens cavity. A valve structure communicates with the lens cavity and is employed to fill the cavity with a suitable fluid of the proper index of refraction. Prior to insertion, and in its unfilled state, the lens cavity is folded and/or rolled and inserted into a probe of minimal diameter. The probe is then introduced through a corneal incision, the lens is pushed from the probe, expands and a syringe attached to the valve structure fills the lens with the proper amount of fluid to create the desired lens optic.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a plan view of an intraocular lens in accordance with the invention.

FIG. **2** is a cross sectional view along line A—A in FIG. **1**.

FIG. **3** is an end view of the intraocular lens in its folded state.

FIG. **4** is a perspective view of the lens inserter probe.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to FIG. **1**, intraocular lens **10** consists of two distinct parts, an optic **12** and two or more haptics **14**, **16**, etc. Optic **12** comprises two sheets **20** and **22** (See FIG. **2**) of an optically transparent, somewhat flexible polymer which is biocompatible. Sheets **20** and **22** are joined around their periphery to form fluid tight capsule. Joined to the periphery of lens **1** are a plurality of haptics, at least one of which, **24** is hollow and communicates with the interior of optic **12**.

Haptic **24** is shown in greater detail in FIG. **2** and includes a lumen **26**. Within lumen **26** are a plurality of shutters **28** which act as a one-way valve through which a fluid can be injected into the interior of optic **12**. It should be clear to one skilled in the art that any suitable one way valve can be utilized, either integral to a haptic or communicating directly with the optic **12**.

Prior to use, optic **12** is "deflated" in that sheets **20** and **22** are collapsed upon one another. In such a condition (See FIG. **3**) intraocular lens **10** may be folded accordion style, rolled or otherwise reduced in size to enable it to be inserted into the lumen of inserting probe **30**. A slideably mounted tube **32** is positioned within probe **30** so as to be able to be operated to push lens **10** into position once probe **30** has been inserted by the surgeon into the eye. Connected to lumen **26** of haptic **24** is an extended needle **34** which is attached to a precision syringe (not shown).

Upon insertion of lens **10** into place, the surgeon injects a biocompatible fluid of proper refractive index through needle **34**, lumen **26**, valve leaflets **28** into the area between sheets **20** and **22**. The amount of injected fluid is precisely metered to achieve the proper lens configuration. Ordinarily, the lens, once inflated, assumes a bioconvex shape but by proper selection of materials, it can be made plano-convex, or concavo-convex.

The fluid, once inserted, does not escape due to the back pressure exerted upon leaflets **28** which causes them to seal lumen **26** to outward fluid flow. After inflation, needle **34** is removed by a twisting withdrawal motion from haptic **24**. Then probe **30** is withdrawn, haptic **24** properly positioned and the wound closed.

Preferably, the haptics and optic are made of the same material. Any material is suitable which is biocom-